

E 100 105 110 115 120 125 130 135 140 145 150 155 160 E

N 35

TYPHOON WARREN
BEST TRACK TC-06W
11 JUL-20 JUL 88
MAX SFC WIND 115KT
MINIMUM SLP 927MBS

LEGEND

- 6-HOUR BEST TRACK POSIT
- A SPEED OF MOVEMENT
- B INTENSITY
- C POSITION AT XX/0000Z
- oooooo TROPICAL DISTURBANCE
- TROPICAL DEPRESSION
- TROPICAL STORM
- TYPHOON
- ◆ SUPER TYPHOON START
- ◇ SUPER TYPHOON END
- ◆◆◆ EXTRATROPICAL
- ◆◆◆ SUBTROPICAL
- *** DISSIPATING STAGE
- F FIRST WARNING ISSUED
- L LAST WARNING ISSUED

L-20/00Z

P-12/18Z

TCFA

ABPV

11C

308

52

EQ

S 5

TYPHOON WARREN (06W)

Typhoon Warren was the first of two significant tropical cyclones to develop during the month of July, and the fourth tropical cyclone of the year to reach typhoon intensity. Warren was a "straight-runner" and maintained a west-northwestward direction of movement during almost its entire life span.

The tropical disturbance that eventually developed into Typhoon Warren was first mentioned on the Significant Tropical Weather Advisory at 110600Z. The suspect area had persisted as a poorly organized area of convection for 12-hours in the eastern Caroline Islands. Its potential for further development was assessed as "poor." However, better convective organization and improved upper-level outflow raised the potential for development into a significant tropical cyclone to "fair" and JTWC reissued the Advisory at 111230Z. Increased convection prompted a Tropical Cyclone Formation Alert at 120530Z. The system was now 180 nm (333 km) southeast of Guam and headed for the island. Satellite intensity analysis estimated sustained surface winds of 25 kt (13 m/sec).

The appearance of a central dense overcast (CDO) on the 121237Z satellite imagery led the satellite analyst to increase the intensity estimate of surface winds to 30 kt (15 m/sec). From 121200Z to 121500Z, the system's CDO increased in size. Because of the disturbance's steady development and its proximity to Guam, JTWC issued an abbreviated warning for the tropical depression at 121600Z: the detailed warning followed at 121800Z. The center of the system passed 55 nm (102 km) to the south of Guam at 130000Z.

After returning to a more westerly track, Tropical Depression 06W was upgraded to Tropical Storm Warren at 130600Z. (Post-analysis showed that Warren probably attained tropical storm intensity earlier at 130000Z.) At 141800Z, Warren reached typhoon intensity. This intensification process continued and

peaked at 115 kt (58 m/sec) in the Philippine Sea 300 nm (556 km) east of Luzon (Figure 3-06-1). During this same two day period as the winds doubled in intensity, Warren also doubled its forward speed to 15 kt (28 km/hr).

While Warren tracked across the Philippine Sea, the One Way (Interactive) Tropical Cyclone Model (OTCM) outlook began to take the track northward into the



Figure 3-06-1. Typhoon Warren at peak intensity (162247Z July NOAA infrared imagery).

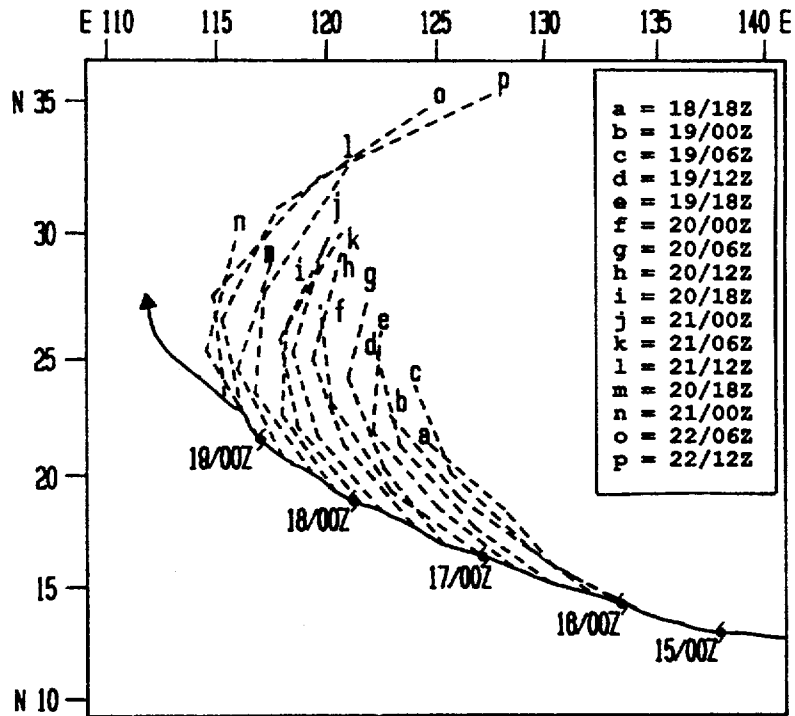


Figure 3-06-2. A comparison of OTCM 72-hour guidance with JTWC's best track. Note OTCM's systematic strong northward bias.

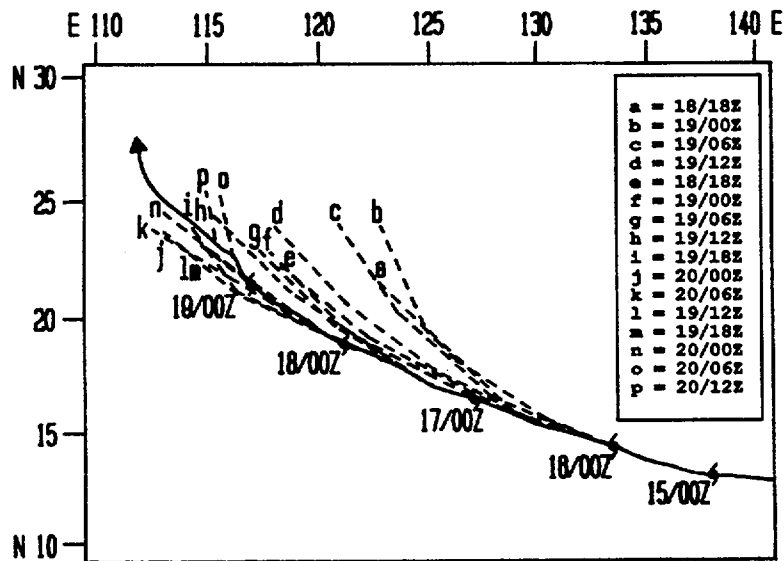


Figure 3-06-3. Seventy-two hour forecasts tended to be north of the best track and more conservative than the OTCM guidance.

subtropical ridge. OTCM is JTWC's operational dynamic aid and in general provides the best performance of all the objective aids. This numerical guidance moved Warren north and east of the island of Taiwan and eventually suggested recurvature within 48- to 72-hours (Figure 3-06-2). However, JTWC's synoptic data analyses and mid-level prognoses maintained the subtropical ridge to the north. This was reinforced by satellite observed persistent minimum cloudiness, which was associated with subsidence and ridging, to the north of Warren. Consequently, recurvature was not forecast (Figure 3-06-3).

From 171800Z to 180000Z, Typhoon Warren weakened as it skirted the northern coast of Luzon with damage to rice and corn crops in northern Luzon estimated to be \$10

million.

After its brush with Luzon, the tropical cyclone maintained typhoon intensity until making landfall at 190600Z (Figure 3-06-4) near the city of Shantou in southeastern China. China's official media reported 17 killed and 153 injured by Warren. Additionally, in the province of Guangdong in southeastern China, over 13,000 homes were destroyed and over 150,000 homes damaged. At 200000Z, JTWC issued its final warning on Tropical Storm Warren with the system well inland and northwest of Hong Kong. The remnants of Warren's low-level circulation continued tracking across southern China for another day before merging with a weak summer front, enhancing cloudiness and precipitation.

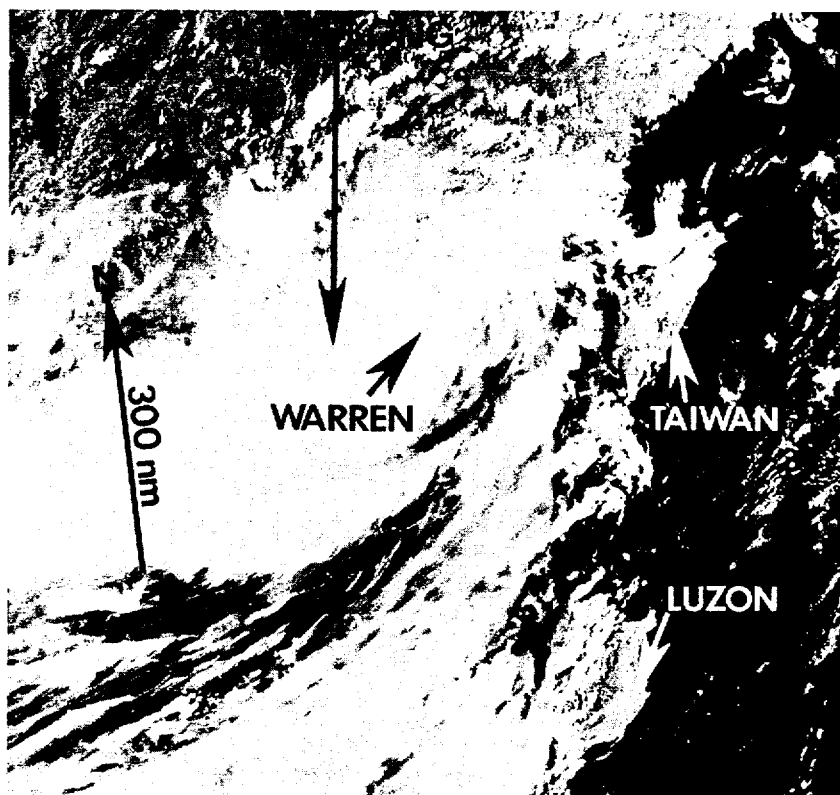


Figure 3-06-4: Tropical Storm Warren after making landfall (190745Z July NOAA visual imagery).